CLAIMS:

1. A rotary tool holder assembly for high speed rotation comprising a collet and a shaft, the collet being moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for rotation, and a tool release position, the shaft comprising a bore for receiving the collet, the shaft and collet shaped such that when the rotary tool holder assembly is rotated at a high speed the inner surface of the shaft bore substantially fits the outer surface of the collet.

2. A rotary tool holder according to claim 1 wherein at least one of the shaft and the collet are arranged such that when the rotary tool holder assembly is rotated at the high speed there is relative deformation between the outer surface of the collet and the inner surface of the shaft bore to give the substantial fit therebetween.

3. A rotary tool holder according to claim 1 or claim 2 wherein a friction reducing coating is provided between at least a portion of the inner surface of the shaft and the outer surface of the collet.

4. A rotary tool holder according to any preceding claim wherein the outer surface of the collet and the inner surface of the shaft are tapered, the collet and the shaft bore tapering inwardly away from a tool receiving mouth of the collet.

5. A rotary tool holder according to claim 4 wherein, when the rotary tool holder is stationary, the taper angle of the collet is greater than the taper angle of the shaft.

6. A rotary tool holder according to claim 5 wherein the difference in taper angle between the inner surface of the shaft and the outer surface of the collet is between 1 and 10 arc minutes.

7. A rotary tool holder assembly according to any preceding claim in which at least a portion of one of the collet and the inner surface of the shaft bore is coated with a friction reducing coating, and preferably at least part of an outer surface of the collet which faces the inner surface of the shaft bore is coated with a friction reducing coating.

8. A rotary tool holder assembly according to claim 1 in which the collet comprises a plurality of jaw portions for gripping an inserted tool, at least one of the collet and the shaft are tapered so that axial movement of the collet relative to the shaft causes or allows the jaw portions of the collet to move in a direction transverse to the axis of the collet for gripping and releasing of an inserted tool.

9. A rotary tool holder assembly according to any preceding claim in which the collet is generally cylindrical and substantially the whole of the outer curved surface of the cylinder is coated with the friction reducing coating.

10. A rotary tool holder assembly according to any preceding claim in which the shaft is arranged to be journalled in a tooling machine and surfaces of the shaft which are arranged to be received in the bearing of the tooling machine are at least partially coated with a friction reducing coating.

11. A rotary tool holder assembly according to any preceding claim in which the collet is carried by a bobbin arranged for axial movement within a

bore of the shaft.

12. A rotary tool holder assembly according to claim 11 in which at least a portion of the bobbin is coated with a friction reducing coating.

13. A rotary tool holder assembly according to claim 11 or claim 12 in which the collet is carried on the bobbin by virtue of being mounted on a stud retained within the bobbin.

14. A rotary tool holder assembly according to claim 11, claim 12 or claim 13 in which a guidebush insert is provided within the bore of the shaft and the bobbin is arranged for axial movement within the guide bush.

15. A rotary tool holder assembly according to claim 14 in which at least a portion of the guidebush is coated with a friction reducing coating.

16. A rotary tool holder assembly according to any preceding claim in which spring means are provided for biasing the collet towards the gripping position.

17. A rotary tool holder assembly according to any one of claims 11 to 15 comprising spring means arranged for acting on the bobbin to bias the collet towards the gripping position.

18. A rotary tool holder assembly according to claim 16 or claim 17 in which at least a portion of the spring means is coated with a friction reducing coating.

19. A rotary tool holder assembly according to any one of claims 16 to 18 in which the spring means is disposed in a spring receiving bore which is provided in the shaft.

20. A rotary tool holder assembly according to claim 19 in which at least a portion of the spring receiving bore is coated with a friction reducing coating.

21. A rotary tool holder assembly according to any preceding claim in which each surface of each component of the assembly that moves in contact with the surface of another assembly component during the insertion and/or release of a tool is coated with a friction reducing coating.

22. A rotary tool holder assembly according to any preceding claim in which the coating has a very low coefficient of friction.

23. A rotary tool holder assembly according to any preceding claim in which the coating is applied to parts using a low temperature process to avoid changing the properties of the materials of the coated components.

24. A rotary tool holder assembly according to any preceding claim in which the coating is sufficiently thin that the coating may be applied after the finishing processes have been carried out on the components and, after coating, the components remain within selected manufacturing tolerances.

25. A rotary tool holder assembly according to any preceding claim in which the coating is useable on heat treated materials without damage.

26. A rotary tool holder assembly according to any preceding claim in

which the coating is compatible with at least one of, or any combination of: solvents, lubricating oils and greases.

27. A rotary tool holder assembly according to any preceding claim in which the coating has a hardness in the region of 30 Rc (Rockwell Hardness scale C).

28. A rotary apparatus comprising a rotary tool holder according to any preceding claim and a tooling machine wherein the predetermined high speed is the maximum operational speed of the tooling machine.

29. A rotary tool holder assembly comprising:
a collet carried by a shaft, the collet being moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for rotation, and a tool release position; and
spring means disposed in a spring receiving bore for biasing the collet towards the gripping position, a friction reducing coating being provided between at least a portion of the spring means and the spring receiving bore.

30. A rotary tool holder assembly according to claim 29 which is arranged for high speed rotation.

31. A rotary tool holder assembly according to claim 29 or claim 30 in which at least one portion of the collet is coated with a friction reducing coating.

32. A rotary tool holder assembly according to any one of claims 29 to 31 in which the shaft comprises a bore for receiving the collet and at least part of

an outer surface of the collet which faces the internal surface of the shaft bore is coated with a friction reducing coating.

33. A rotary tool holder assembly according to claim 32 in which at least part of the internal surface of the shaft bore is coated with a friction reducing coating.

34. A rotary tool holder assembly according to any one of claims 29 to 33 in which the collet comprises a plurality of jaw portions for gripping an inserted tool, at least one of the collet and the shaft are tapered so that axial movement of the collet relative to the shaft causes or allows the jaw portions of the collet to move in a direction transverse to the axis of the collet for gripping and releasing of an inserted tool and at least some of the taper surfaces of the collet and/or the shaft are coated with a friction reducing coating.

35. A rotary tool holder assembly according to any one of claims 29 to 34 in which the collet comprises taper surfaces which are coated with a friction reducing coating.

36. A rotary tool holder assembly according to any one of claims 29 to 35 in which the collet is generally cylindrical and substantially the whole of the outer curved surface of the cylinder is coated with the friction reducing coating.

37. A rotary tool holder assembly according to any one of claims 29 to 36 in which the shaft is arranged to be journalled in a tooling machine and surfaces of the shaft which are arranged to be received in the bearing of the

tooling machine are at least partially coated with a friction reducing coating.

38. A rotary tool holder assembly according to any one of claims 29 to 37 in which the collet is carried by a bobbin arranged for axial movement within a bore of the shaft.

39. A rotary tool holder assembly according to claim 38 in which at least a portion of the bobbin is coated with a friction reducing coating.

40. A rotary tool holder assembly according to claim 38 or claim 39 in which the collet is carried on the bobbin by virtue of being mounted on a stud retained within the bobbin.

41. A rotary tool holder assembly according to claim 38, claim 39 or claim 40 in which a guidebush insert is provided within the bore of the shaft and the bobbin is arranged for axial movement within the guide bush.

42. A rotary tool holder assembly according to claim 41 in which at least a portion of the guidebush is coated with a friction reducing coating.

43. A rotary tool holder assembly according to any one of claims 38 to 42 in which the spring means is arranged for acting on the bobbin to bias the collet towards the gripping position.

44. A rotary tool holder according to any one of claims 29 to 43 wherein at least a portion of the spring means is coated with a friction reducing coating.

45. A rotary tool holder assembly according to claim 44 in which at least a

portion of the spring receiving bore is coated with a friction reducing coating.

46. A rotary tool holder assembly according to any one of claims 29 to 45 in which each surface of each component of the assembly that moves in contact with the surface of another assembly component during the insertion and/or release of a tool is coated with a friction reducing coating.

47. A rotary tool holder assembly according to any one of claims 29 to 46 in which the coating has a very low coefficient of friction.

48. A rotary tool holder assembly according to any one of claims 29 to 47 in which the coating is applied to parts using a low temperature process to avoid changing the properties of the materials of the coated components.

49. A rotary tool holder assembly according to any one of claims 29 to 48 in which the coating is sufficiently thin that the coating may be applied after the finishing processes have been carried out on the components and, after coating, the components remain within selected manufacturing tolerances.

50. A rotary tool holder assembly according to any one of claims 29 to 49 in which the coating is useable on heat treated materials without damage.

51. A rotary tool holder assembly according to any one of claims 29 to 50 in which the coating is compatible with at least one of, or any combination of: solvents, lubricating oils and greases.

52. A rotary tool holder assembly according to any one of claims 29 to 51 in which the coating has a hardness in the region of 30 Rc (Rockwell Hardness

scale C).

53. A rotary tool holder assembly comprising a collet carried by a shaft, wherein the collet is moveable relative to the shaft between a tool gripping position in which an inserted tool can be gripped for rotation and a tool release position, the collet is carried by a bobbin arranged for axial movement within a bore of the shaft and a friction reducing coating is provided between at least a portion of the bobbin and the bore of the shaft.

54. A rotary tool holder assembly according to claim 53 which is arranged for high speed rotation.

55. A rotary tool holder assembly according to claim 53 or claim 54 in which at least one portion of the collet is coated with a friction reducing coating.

56. A rotary tool holder assembly according to any one of claims 53 to 55 in which the shaft comprises a bore for receiving the collet and at least part of an outer surface of the collet which faces the internal surface of the shaft bore is coated with a friction reducing coating.

57. A rotary tool holder assembly according to claim 56 in which at least part of the internal surface of the shaft bore is coated with a friction reducing coating.

58. A rotary tool holder assembly according to any one of claims 53 to 57 in which the collet comprises a plurality of jaw portions for gripping an inserted tool, at least one of the collet and the shaft are tapered so that axial

movement of the collet relative to the shaft causes or allows the jaw portions of the collet to move in a direction transverse to the axis of the collet for gripping and releasing of an inserted tool and at least some of the taper surfaces of the collet and/or the shaft are coated with a friction reducing coating.

59. A rotary tool holder assembly according to any one of claims 53 to 58 in which the collet comprises taper surfaces which are coated with a friction reducing coating.

60. A rotary tool holder assembly according to any one of claims 53 to 59 in which the collet is generally cylindrical and substantially the whole of the outer curved surface of the cylinder is coated with the friction reducing coating.

61. A rotary tool holder assembly according to any one of claims 53 to 60 in which the shaft is arranged to be journalled in a tooling machine and surfaces of the shaft which are arranged to be received in the bearing of the tooling machine are at least partially coated with a friction reducing coating.

62. A rotary tool holder assembly according to any one of claims 53 to 61 in which the collet is carried on the bobbin by virtue of being mounted on a stud retained within the bobbin.

63. A rotary tool holder assembly according to any one of claims 63 to 62 in which at least a portion of the bobbin is coated with a friction reducing coating.

64. A rotary tool holder assembly according to any one of claims 53 to 63

in which a guidebush insert is provided within the bore of the shaft and the bobbin is arranged for axial movement within the guide bush.

65. A rotary tool holder assembly according to claim 64 in which at least a portion of the guidebush is coated with a friction reducing coating.

66. A rotary tool holder assembly according to any one of claims 53 to 65 in which spring means are provided for biasing the collet towards the gripping position.

67. A rotary tool holder assembly according to any one of claims 53 to 66 comprising spring means arranged for acting on the bobbin to bias the collet towards the gripping position.

68. A rotary tool holder assembly according to claim 66 or claim 67 in which at least a portion of the spring means is coated with a friction reducing coating.

69. A rotary tool holder assembly according to any one of claims 66 to 68 in which the spring means is disposed in a spring receiving bore which is provided in the shaft.

70. A rotary tool holder assembly according to claim 69 in which at least a portion of the spring receiving bore is coated with a friction reducing coating.

71. A rotary tool holder assembly according to any one of claims 53 to 70 in which each surface of each component of the assembly that moves in contact with the surface of another assembly component during the insertion

and/or release of a tool is coated with a friction reducing coating.

72. A rotary tool holder assembly according to any one of claims 53 to 71 in which the coating has a very low coefficient of friction.

73. A rotary tool holder assembly according to any one of claims 53 to 72 in which the coating is applied to parts using a low temperature process to avoid changing the properties of the materials of the coated components.

74. A rotary tool holder assembly according to any one of claims 53 to 73 in which the coating is sufficiently thin that the coating may be applied after the finishing processes have been carried out on the components and, after coating, the components remain within selected manufacturing tolerances.

75. A rotary tool holder assembly according to any one of claims 53 to 74 in which the coating is useable on heat treated materials without damage.

76. A rotary tool holder assembly according to any one of claims 53 to 75 in which the coating is compatible with at least one of, or any combination of: solvents, lubricating oils and greases.

77. A rotary tool holder assembly according to any one of claims 53 to 76 in which the coating has a hardness in the region of 30 Rc (Rockwell Hardness scale C).

78. A method of manufacturing a rotary tool holder assembly comprising a collet carried by a shaft, wherein the collet is moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for

rotation, and a tool release position, and a spring means disposed in a spring receiving bore for biasing the collet towards the gripping position the method comprising the steps of machining and finishing a plurality of component parts of the assembly within selected manufacturing tolerances and after the machining and finishing steps, applying a friction reducing coating between at least one portion of the spring means and the spring receiving bore without causing the dimensions of the coated component to fall outside of the selected tolerances.

79. A method of manufacturing a rotary tool holder assembly comprising a collet carried by a shaft, wherein the collet is moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for rotation, and a tool release position, and the collet is carried by a bobbin arranged for axial movement within the bore of the shaft, the method comprising the steps of machining and finishing a plurality of component parts of the assembly within selected manufacturing tolerances and after the machining and finishing steps, applying a friction reducing coating between at least one portion of the bobbin and the bore of the shaft without causing the dimensions of the coated component to fall outside of the selected tolerances.

80. A rotary tool holder comprising:
a collet carried by a shaft, the collet being moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for rotation, and a tool release position; and
spring means disposed in a spring receiving bore for biasing the collet towards the gripping position, a friction reducing coating being provided between at least a portion of the spring means and the spring receiving bore,
wherein the collet is carried by a bobbin arranged for axial movement within a

bore of the shaft, a friction reducing coating being provided between at least a portion of the bobbin and the bore of the shaft.

81. A rotary tool holder comprising:

a collet carried by a shaft, the collet being moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for rotation, and a tool release position; and

a spring disposed in a spring receiving bore for biasing the collet towards the gripping position, a friction reducing coating being provided between at least a portion of the spring and the spring receiving bore,

wherein the collet is carried by a bobbin arranged for axial movement within a bore of the shaft, a friction reducing coating being provided between at least a portion of the bobbin and the bore of the shaft.

82. A rotary tool holder comprising:

a collet carried by a shaft, the collet being moveable relative to the shaft between a tool gripping position, in which an inserted tool can be gripped for rotation, and a tool release position; and

means for biasing the collet towards the gripping position disposed in a receiving bore, a friction reducing coating being provided between at least a portion of the means for biasing the collet and the receiving bore,

wherein the collet is carried by a bobbin arranged for axial movement within a bore of the shaft, a friction reducing coating being provided between at least a portion of the bobbin and the bore of the shaft.